NICST Internal Memo

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Subject: Analysis of VIIRS F1 Relative Spectral Response for the SMWIR FPA

References:

[1] TP154640-265, 'Relative Spectral Response, In Band (FP-15) Test Procedure for – VIIRS.'
[2] TP154640-266, 'Relative Spectral Response, Out Of Band and Band-Point Crosstalk (FP-16) Test Procedure for – VIIRS.'
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[4] ps154640-101, 'Performance Specification Sensor Specification.'
[5] NICST_REPORT_09_065, 'Emissive Band Spectral Response: Preliminary Analysis (A Side),' J. McIntire, July 6, 2009.
[6] NICST_REPORT_09_067, 'Emissive Band Spectral Response: Preliminary Analysis (B Side),' J. McIntire, July 7, 2009.
[7] NICST_REPORT_09_090, 'Emissive Band RSR: Preliminary Analysis,' J. McIntire and N. Che, July 22, 2009.
[8] NICST_MEMO_10_002, 'Analysis of VIIRS F1 Relative Spectral Response for the LWIR FPA,' J. McIntire, T. Schwarting, N. Che, and C. Pan, February 22, 2010.
[9] MODTRAN (3.7/4.0)
[10] NICST_MEMO_06_031,'VIIRS EDU Preliminary In-band RSR for the Cold Focal Planes,' D. Moyer, N. Che, and J. Xiong, August 24, 2006.

1. Introduction

FP-15 Part 2 and FP-16 Part 2 were performed during VIIRS TV testing (Nominal plateau) in order to determine the spectral characteristics of VIIRS cold focal planes [1-3]. This work will focus on the SMWIR In-Band (IB) and Out-Of-Band (OOB) sections of the Relative Spectral Response (RSR) as well as assess compliance with the associated specifications [4]. Preliminary results were reported in [5-7].

The test configuration for both FP-15 and FP-16 was described in [8]. In addition, the data analysis methodology used in this work was also detailed in [8]. As a result neither the bulk of the test configuration details nor the data analysis methodology will be repeated here.

For FP-16, the SMWIR focal plane was sampled over a wavelength range of approximately 1 – 7 μm. An example of RSO used in this work over the OOB region measured for SMWIR bands is shown in Figure 1. Figure 2 shows a schematic of the IB

metrics. Tables 1 – 4 list the UAID, number of collects, band, detector row, order filter number, grating number, ND filter (used only for FP-16 IB measurements), and wavelength range.
The spectral smile of the source (SpMA) was measured for all bands in the SMWIR FPA (except for I4 odd). This correction is applied using the following formula

$$\lambda_{COR}(C,B,D,T) = \lambda(C,B,D,T) + \lambda_{SMILE}(B,D) \quad (1)$$

to all FP-15 and FP-16 data sets. Here C, B, D, and T represent the collect, detector, and test (FP-15, FP-16 IB, or FP-16 OOB).

2. Analysis Results

The IB RSR for band M8 is graphed in Figure 3 as a function of wavelength. The main peak is on the short side of the bandpass; the response is relatively flat at around 95 % of peak response over the remainder of the bandpass. The M8 IB metrics are listed in Tables 5 – 7. All IB metrics for this band are within the specified limits for all detectors, except for the bandwidth. The M8 bandwidth is about 6 nm longer than the specified bandwidth (20 nm) and 2 nm outside the specified tolerance (±4 nm). The ND filter transmission results are listed in Table 6. The detector averaged derived ND transmission is 0.0160 for the odd detectors and 0.0154 for the even detectors with an average standard deviation of 0.0002 (odd) and 0.0002 (even). A 1.9 ND filter was used for the odd detectors and a 1.8 ND filter was used for the even detectors; this corresponds to theoretical transmissions of 0.0126 (odd) and 0.0158 (even). The full RSR curve including the OOB is shown in Figure 4. There is some OOB structure between 1400 and 2300 nm including two prominent spikes (one around 2000 nm with a response of just below 10^{-2} and another close to 2300 nm with a response around 10^{-4}). Elsewhere the response is at or near the noise floor (around 10^{-7}). The IOOB results are listed in Table 7. For M8, all detectors are well within the specified limit of 0.8 % (the average value is 0.59 %).

Figure 5 plots the IB RSR for band M9 as a function of wavelength. There are a number of jagged peaks within the bandpass; this is the result of strong water vapor absorption within the M9 bandpass. Tables 8 – 10 list the IB metrics for M9. All detectors for this band are within the specified limits for all the IB metrics. Table 9 contains the ND filter transmission results for M9. A 2.6 ND filter was used for all detectors; the corresponding theoretical transmission of 0.0025. The measured transmission (averaged over detectors) is 0.0033 with an average standard deviation of 0.0003. Table 10 contains the results of the IOOB calculation for M9. All detectors are well within the specified limit of 1.0 % (the average value is 0.55 %). The full OOB RSR curve is shown in Figure 6. Some OOB structure is observed in the 1600 – 2600 nm region (generally around 10^{-5} of peak response); there is a prominent spike at roughly 2500 nm with a response of around 10^{-3}. All other wavelength regions are at or near the noise floor (around 10^{-7}).

The M9 bandpass covers a region of strong water absorption. To estimate the impact of this effect, MODTRAN data was used to estimate the percent change in radiance due to a shift in center wavelength that might result from atmospheric effects [9]. The simulation

is run for a standard (1976) atmospheric profile over ocean. The results are listed in Table 11. For a shift of ±2 nm, the maximum radiance shift is 0.02 %. Comparable MODIS bands (band 26) shifts by up to 4.77 % for Terra.

A plot of the IB RSR as a function of wavelength is shown in Figure 7 for band M10. The main peak is on the long side of the bandpass; on the short side of the bandpass there is a smaller peak in which some detector variation is observed. The IB metrics for M10 are shown in Tables 12 – 14. All detectors for this band are within the specified limits for all the IB metrics. The ND filter transmission results for M10 are listed in Table 13. The mean measured transmission is 0.0186 with a mean standard deviation of 0.0010. A 1.8 ND filter was used, which corresponds to a theoretical transmission of 0.016. The IOOB results are listed in Table 14. The average IOOB over detectors is 0.47 %, which is within the specified limit of 0.7 %. Figure 8 displays the full OOB RSR curve. Aside from the main peak inside the M10 bandpass, there is a small peak (with about 10^{-4} RSR) in the region of 2100 nm that is about 200 nm wide. All other features are at around 10^{-6} of the peak response or lower.

The M11 IB RSR is plotted as a function of wavelength in Figure 9. There are two peaks within the bandpass of about the same magnitude with a 10 % dip between them. The peak on the long end of the bandpass is broader and more uniform over detectors; the peak on the short end of the bandpass is narrower and higher number detectors exhibit a slightly lower response. Tables 15 – 17 list the IB metrics for M11. All detectors for this band are within the specified limits for all the IB metrics. Table 16 displays the ND filter transmission results. The M11 testing used different filters for odd and even detector arrays (1.3 and 1.2, respectively); the corresponding theoretical transmissions are 0.050 and 0.063. The odd detectors had an average ND filter transmission of 0.0436 with an average standard deviation of 0.0020 and the even detectors had a mean ND filter transmission of 0.0553 with an mean standard deviation of 0.0014. Table 17 lists the IOOB results; the average IOOB for M11 is 0.43 % (the specified limit is 1.0 %). The full OOB RSR curve is shown in Figure 10. All OOB features are on the 10^{-6} level for M11.

Figure 11 shows the IB RSR for band M12 as a function of wavelength. There is a small side peak on the long side of the bandpass for lower number odd detectors and there is some detector difference on the short side of the peak also in lower number odd detectors. Tables 18 – 20 contain the IB RSR metrics for M12. All detectors for this band are within the specified limits for all the IB metrics. The ND filter transmission results are listed in Table 19. A 1.6 ND filter was used for M12, which corresponds to a transmission of 0.025. The measured average transmission of the ND filter was 0.0275 with an average standard deviation of 0.0020. The IOOB for M12 was 0.37 % (averaged over detectors), which is well below the specified limit of 1.1 %. The IOOB results are listed in Table 20. Figure 12 shows the full OOB RSR curve. All OOB features are on the 10^{-6} level for M12.

The M13 IB RSR is graphed in Figure 13 as a function of wavelength. The peak of the IB RSR is relatively flat to within 5 % of the peak response over the range of 4020 to 4120 nm. The IB RSR metrics for band M13 are listed in Tables 21 – 23. All detectors for this

band are within the specified limits for all the IB metrics. The measured ND filter transmission per detector is listed in Table 22. The average transmission is 0.0576 and the average standard deviation is 0.0037. The theoretical transmission for a 1.3 ND filter is 0.05. The IOOB results for M13 are listed in Table 23. The average IOOB of 0.42 % is well below the specified limit of 1.3 %. The full M13 OOB RSR curve is shown in Figure 14. There is a small feature on the long side of the bandpass (around 4250 nm) with a peak at about 10^{-2}; the gap between this feature and the main peak results from atmospheric absorption (CO_2). No other features are evident above the noise floor (10^{-6} of peak response).

Figure 15 shows the I3 SS1 IB RSR as a function of wavelength. The peak is on the long side of the bandpass; on the short side of the bandpass, there is a smaller peak at about 90 % of the peak response with a gap between the two peaks at about 80 %. Tables 24 – 29 display the IB metrics for I3 SS1. All detectors for this band are within the specified limits for all the IB metrics. For I3, different ND filters were used during the measurements of the odd (1.7) and even (2.0) detectors; this translates into theoretical transmissions of 0.02 and 0.01, respectively. The measured ND transmissions are listed in Table 26 and 27. The average transmission for the odd detectors is 0.0211 with an average standard deviation of 0.0007; the mean transmission for the even detectors is 0.0121 with a mean standard deviation of 0.0005. The results of the IOOB calculation are listed in Tables 28 and 29. The average IOOB is 0.50% which is within the specified limit of 0.7 %. Figure 16 graphs the full OOB RSR curve for I3 SS1. The I3 RSR curve is similar to that of M10; the only feature is a small OOB peak (below 10^{-4} of peak response) in the region of 2100 nm.

The I4 SS1 IB RSR is plotted in Figure 17 as a function of wavelength. The peak is on the long side of the bandpass. There are four successively smaller peaks (including the main one) as the wavelength decreases over the bandpass; these peaks are about 100 nm apart and the lowest (on the short side of the bandpass) is approximately 80 % of the peak response. The IB metrics for I4 SS1 are listed in Tables 30 – 35. All detectors for this band are within the specified limits for all the IB metrics. As with I3, the odd and even detectors were measured with different ND filters; the 1.3 (odd) and 1.0 (even) ND filters correspond to theoretical transmissions of 0.05 and 0.1, respectively. Tables 32 and 33 list the ND filter transmission results. The average transmissions for the odd and even detectors are 0.0574 and 0.0869 with mean standard deviations of 0.0013 and 0.0050, respectively. The average IOOB for I4 SS1 is 0.24 % (the specified limit is 0.5 %); the IOOB results are listed in Tables 34 and 35. The full OOB RSR curve for I4 SS1 is shown in Figure 18. There are no OOB features evident above the noise floor (10^{-6} peak response).

Figure 19 shows the deviation of the center wavelength from the average for all SMWIR bands. In general, the center wavelengths for the SMWIR bands trend downward with decreasing detector number. There is strong odd – even detector dependence in the center wavelength for I4. The total variation for all bands does not exceed 5 nm over all detectors in a given band. Note that for the SMWIR bands, a SpMA spectral smile correction was applied for all bands except even detectors in I4.

The spectral characteristics listed in this work (particularly the non-compliances) need to be evaluated in terms of their impact on the Environmental Data Record (EDR). The driving EDRs for the SMWIR bands are Cloud Imagery (I4), SST (M12 and M13), Fire (M13), Clouds (M11), Snow Fraction (M10), Binary Snow Map (I3), Cirrus/Cloud Cover (M9), and Cloud Particle Size (M8).

In general, the EDU RSR measurements are comparable to F1 in terms of the IB metrics (see [10]). The one exception in the SMWIR focal plane is M8. For EDU, M8 had a bandwidth of 13 nm; in contrast, F1 M8 has a bandwidth of 26 nm. Figure 20 shows the odd EDU IB RSR (minus edge detectors). Note that no SpMA spectral smile correction was made for EDU SMWIR bands (there is a small shift in wavelength for the entire profile from detector to detector).

3. Summary

- VIIRS F1 SMWIR spectral characteristics are largely within the specifications. All non-compliances are well characterized by the measurements. The following metrics are non-compliant:
    - Bandwidth: M8 (all detectors).
- VIIRS F1 SMWIR spectral characteristics are generally consistent with VIIRS EDU measurements. The exception is M8; the bandwidth was approximately 13 nm for EDU and 26 nm for F1. In both sensors the bandwidth was non-compliant.
- Atmospheric effect on radiance of band M9 estimated from MODTRAN data to be less than 0.02 % for a shift in center wavelength of ±2 nm.

Acknowledgement

The sensor test data used in this document was provided by the Raytheon El Segundo testing team. Approaches for data acquisition and data reductions, as well as data extraction tools were also provided by the Raytheon. We would like to thank the Raytheon El Segundo team for their support. The data analysis tools were developed by the NICST team, and we would like to extend our gratitude for their valued assistance.

Table 1: VIIRS F1 FP-15 and FP-16 SMWIR IB RSR data

FP15 IB							
UAID	# of Collects	Band	Odd/Even	Grating #	Filter #	ND	Wavelength range
3103562	73	M13	odd	3	12	N/A	3782 - 4329
3103579	73	M13	even	3	12	N/A	3782 - 4329
3103680	94	M12	odd	3	12	N/A	3401 - 4015
3103721	94	M12	even	3	12	N/A	3401 - 4015
3103735	211	I4	odd	3	12	N/A	3326 - 4166
3103926	211	I4	even	3	12	N/A	3326 - 4166
3103940	104	M8	odd	2	7	N/A	1204 - 1276
3103963	104	M8	even	2	7	N/A	1204 - 1276
3103989	211	M10	odd	2	7	N/A	1506 - 1716
3104002	211	M10	even	2	7	N/A	1506 - 1716
3104015	136	M11	even	2	8	N/A	2164 - 2340
3104036	136	M11	odd	2	8	N/A	2164 - 2340
3104048	140	M9	even	2	7	N/A	1350 - 1406
3104061	140	M9	odd	2	7	N/A	1350 - 1406
3104075	211	I3	odd	2	7	N/A	1506 - 1716
3104092	211	I3	even	2	7	N/A	1506 - 1716
FP16 IB							
UAID	# of Collects	Band	Odd/Even	Grating #	Filter #	ND	Wavelength range
3103568	19	M13	odd	3	12	1.3	3782 - 4340
3103585	19	M13	even	3	12	1.3	3782 - 4340
3103684	13	M12	odd	3	12	1.6	3401 - 4049
3103725	13	M12	even	3	12	1.6	3401 - 4049
3103739	16	I4	odd	3	12	1.3	3326 - 4166
3103930	16	I4	even	3	12	1.0	3326 - 4166
3103969	19	M8	even	2	7	1.8	1204 - 1276
3103980	19	M8	odd	2	7	1.9	1204 - 1276
3103993	19	M10	odd	2	7	1.8	1506 - 1722
3104006	19	M10	even	2	7	1.8	1506 - 1722
3104028	13	M11	even	2	8	1.2	2164 - 2344
3104040	13	M11	odd	2	8	1.3	2164 - 2344
3104052	14	M9	even	2	7	2.6	1350 - 1409
3104065	14	M9	odd	2	7	2.6	1350 - 1409
3104079	19	I3	odd	2	7	1.7	1506 - 1722
3104097	19	I3	even	2	7	2.0	1506 - 1722

Table 2: VIIRS F1 FP-16 SMWIR OOB RSR data

FP16 OOB						
UAID	# of Collects	Band	Odd/Even	Grating #	Filter #	Wavelength range
3103569	79	M13	odd	2	7	1000 - 2248
3103570	15	M13	odd	2	8	2200 - 2424
3103571	36	M13	odd	2	4	2370 - 2930
3103572	15	M13	odd	3	12	2852 - 3720
3103573	19	M13	odd	3	12	3782 - 4340
3103574	18	M13	odd	3	12	4402 - 5456
3103575	31	M13	odd	3	10	5146 - 7093
3103586	79	M13	even	2	7	1000 - 2248
3103587	15	M13	even	2	8	2200 - 2424
3103588	36	M13	even	2	4	2370 - 2930
3103589	15	M13	even	3	12	2852 - 3720
3103590	19	M13	even	3	12	3782 - 4340
3103591	18	M13	even	3	12	4402 - 5456
3103593	31	M13	even	3	10	5146 - 7093
3103685	79	M12	odd	2	7	1000 - 2248
3103686	15	M12	odd	2	8	2200 - 2424
3103687	36	M12	odd	2	4	2370 - 2930
3103688	9	M12	odd	3	12	2915 - 3347
3103689	13	M12	odd	3	12	3401 - 4049
3103690	27	M12	odd	3	12	4103 - 5507
3103691	31	M12	odd	3	10	5237 - 7187
3103726	79	M12	even	2	7	1000 - 2248
3103727	15	M12	even	2	8	2200 - 2424
3103728	36	M12	even	2	4	2370 - 2930
3103729	9	M12	even	3	12	2915 - 3347
3103730	13	M12	even	3	12	3401 - 4049
3103731	27	M12	even	3	12	4103 - 5507
3103732	31	M12	even	3	10	5237 - 7187
3103740	90	I4	odd	2	7	1000 - 2246
3103741	16	I4	odd	2	8	2200 - 2410
3103742	36	I4	odd	2	4	2370 - 2930
3103743	8	I4	odd	3	12	2878 - 3270
3103744	16	I4	odd	3	12	3326 - 4166
3103745	24	I4	odd	3	12	4222 - 5510
3103746	35	I4	odd	3	10	5230 - 7134

Table 3: VIIRS F1 FP-16 SMWIR OOB RSR data

FP16 OOB						
UAID	# of Collects	Band	Odd/Even	Grating #	Filter #	Wavelength range
3103931	90	I4	even	2	7	1000 - 2246
3103932	16	I4	even	2	8	2200 - 2410
3103933	36	I4	even	2	4	2370 - 2930
3103934	8	I4	even	3	12	2878 - 3270
3103935	16	I4	even	3	12	3326 - 4166
3103936	24	I4	even	3	12	4222 - 5510
3103937	35	I4	even	3	10	5230 - 7134
3103970	13	M8	even	2	7	996 - 1188
3103971	19	M8	even	2	7	1204 - 1276
3103972	61	M8	even	2	7	1284 - 2244
3103973	15	M8	even	2	8	2200 - 2424
3103975	36	M8	even	2	4	2370 - 2930
3103976	42	M8	even	3	12	2788 - 5453
3103977	33	M8	even	3	10	5128 - 7208
3103981	13	M8	odd	2	7	996 - 1188
3103982	19	M8	odd	2	7	1204 - 1276
3103983	61	M8	odd	2	7	1284 - 2244
3103984	15	M8	odd	2	8	2200 - 2424
3103985	36	M8	odd	2	4	2370 - 2930
3103986	42	M8	odd	3	12	2788 - 5453
3103987	33	M8	odd	3	10	5128 - 7208
3103994	42	M10	odd	2	7	1002 - 1491
3103995	19	M10	odd	2	7	1506 - 1722
3103996	43	M10	odd	2	7	1734 - 2238
3103997	19	M10	odd	2	8	2200 - 2416
3103998	19	M10	odd	2	4	2370 - 2930
3103999	36	M10	odd	3	12	2806 - 5471
3104000	42	M10	odd	3	10	5146 - 7096
3104007	42	M10	even	2	7	1002 - 1491
3104008	19	M10	even	2	7	1506 - 1722
3104009	43	M10	even	2	7	1734 - 2238
3104010	19	M10	even	2	8	2200 - 2416
3104011	19	M10	even	2	4	2370 - 2930
3104012	36	M10	even	3	12	2806 - 5471
3104013	42	M10	even	3	10	5146 - 7096

Table 4: VIIRS F1 FP-16 SMWIR OOB RSR data

FP16 OOB						
UAID	# of Collects	Band	Odd/Even	Grating #	Filter #	Wavelength range
3104029	78	M11	even	2	7	994 - 2149
3104030	13	M11	even	2	8	2164 - 2344
3104031	5	M11	even	2	8	2360 - 2424
3104032	36	M11	even	2	4	2370 - 2930
3104033	42	M11	even	3	12	2781 - 5446
3104034	33	M11	even	3	10	5121 - 7201
3104041	78	M11	odd	2	7	994 - 2149
3104042	13	M11	odd	2	8	2164 - 2344
3104043	5	M11	odd	2	8	2360 - 2424
3104044	36	M11	odd	2	4	2370 - 2930
3104045	42	M11	odd	3	12	2781 - 5446
3104046	33	M11	odd	3	10	5121 - 7201
3104053	24	M9	even	2	7	990 - 1335
3104054	14	M9	even	2	7	1350 - 1409
3104055	60	M9	even	2	7	1420 - 2246
3104056	16	M9	even	2	8	2200 - 2410
3104057	36	M9	even	2	4	2370 - 2930
3104058	42	M9	even	3	12	2779 - 5444
3104059	33	M9	even	3	10	5119 - 7199
3104066	24	M9	odd	2	7	990 - 1335
3104067	14	M9	odd	2	7	1350 - 1409
3104068	60	M9	odd	2	7	1420 - 2246
3104069	16	M9	odd	2	8	2200 - 2410
3104070	36	M9	odd	2	4	2370 - 2930
3104071	42	M9	odd	3	12	2779 - 5444
3104072	33	M9	odd	3	10	5119 - 7199
3104080	43	I3	odd	2	7	990 - 1494
3104081	19	I3	odd	2	7	1506 - 1722
3104082	44	I3	odd	2	7	1734 - 2250
3104083	19	I3	odd	2	8	2200 - 2416
3104084	36	I3	odd	2	4	2370 - 2930
3104085	50	I3	odd	3	12	2810 - 5554
3104086	33	I3	odd	3	10	5274 - 7066
3104098	43	I3	even	2	7	990 - 1494
3104099	19	I3	even	2	7	1506 - 1722
3104100	44	I3	even	2	7	1734 - 2250
3104101	19	I3	even	2	8	2200 - 2416
3104102	36	I3	even	2	4	2370 - 2930
3104103	50	I3	even	3	12	2810 - 5554
3104104	33	I3	even	3	10	5274 - 7066

Table 5: Center wavelength and bandwidth for M8

Band	E side	Detector	Measurement		Specification		Measurement	Specification	
			Center	Centroid	Center	Tolerance	Bandwidth	Bandwidth	Tolerance
M8	B	1	1237.9	1238.0	1240	5	26.1	20	4
M8	B	2	1238.0	1238.1	1240	5	26.1	20	4
M8	B	3	1238.1	1238.2	1240	5	26.0	20	4
M8	B	4	1238.2	1238.3	1240	5	26.1	20	4
M8	B	5	1238.3	1238.4	1240	5	26.1	20	4
M8	B	6	1238.4	1238.4	1240	5	26.1	20	4
M8	B	7	1238.5	1238.6	1240	5	26.1	20	4
M8	B	8	1238.5	1238.6	1240	5	26.1	20	4
M8	B	9	1238.5	1238.6	1240	5	26.2	20	4
M8	B	10	1238.5	1238.6	1240	5	26.2	20	4
M8	B	11	1238.6	1238.7	1240	5	26.3	20	4
M8	B	12	1238.4	1238.5	1240	5	26.3	20	4
M8	B	13	1238.7	1238.8	1240	5	26.3	20	4
M8	B	14	1238.2	1238.3	1240	5	26.4	20	4
M8	B	15	1238.7	1238.8	1240	5	26.3	20	4
M8	B	16	1237.8	1237.8	1240	5	26.5	20	4

Table 6: ND filter transmission for M8

Band	E side	Detector	Measurement		ND filter	Theoretical ND trans
			ND trans	Stddev of ND		
M8	B	1	0.0158	0.0001	1.9	0.013
M8	B	2	0.0165	0.0002	1.8	0.016
M8	B	3	0.0162	0.0003	1.9	0.013
M8	B	4	0.0164	0.0001	1.8	0.016
M8	B	5	0.0159	0.0001	1.9	0.013
M8	B	6	0.0166	0.0002	1.8	0.016
M8	B	7	0.0161	0.0001	1.9	0.013
M8	B	8	0.0167	0.0003	1.8	0.016
M8	B	9	0.0161	0.0001	1.9	0.013
M8	B	10	0.0163	0.0002	1.8	0.016
M8	B	11	0.0163	0.0001	1.9	0.013
M8	B	12	0.0156	0.0003	1.8	0.016
M8	B	13	0.0159	0.0002	1.9	0.013
M8	B	14	0.0134	0.0001	1.8	0.016
M8	B	15	0.0158	0.0003	1.9	0.013
M8	B	16	0.0117	0.0003	1.8	0.016

Table 7: 1 % limits and IOOB for M8

Band	E side	Detector	Measurement		Specification		IOOB (%)	
			Lower 1% limit	Upper 1% limit	Lower 1% limit	Upper 1% limit	Measurement	Specification
M8	B	1	1212.9	1264.5	1205	1275	0.65	0.8
M8	B	2	1213.1	1264.7	1205	1275	0.63	0.8
M8	B	3	1213.2	1264.6	1205	1275	0.63	0.8
M8	B	4	1213.4	1264.9	1205	1275	0.59	0.8
M8	B	5	1213.5	1264.8	1205	1275	0.62	0.8
M8	B	6	1213.6	1265.0	1205	1275	0.58	0.8
M8	B	7	1213.6	1265.1	1205	1275	0.61	0.8
M8	B	8	1213.8	1265.3	1205	1275	0.56	0.8
M8	B	9	1213.7	1265.2	1205	1275	0.58	0.8
M8	B	10	1213.7	1265.3	1205	1275	0.55	0.8
M8	B	11	1213.4	1265.6	1205	1275	0.57	0.8
M8	B	12	1213.5	1265.4	1205	1275	0.54	0.8
M8	B	13	1213.6	1265.8	1205	1275	0.58	0.8
M8	B	14	1213.3	1265.4	1205	1275	0.56	0.8
M8	B	15	1213.6	1265.8	1205	1275	0.59	0.8
M8	B	16	1212.7	1265.1	1205	1275	0.36	0.8

Table 8: Center wavelength and bandwidth for M9

Band	E side	Detector	Measurement		Specification		Measurement	Specification	
			Center	Centroid	Center	Tolerance	Bandwidth	Bandwidth	Tolerance
M9	A	1	1374.7	1374.6	1378	4	14.8	15	3
M9	A	2	1375.0	1374.8	1378	4	14.7	15	3
M9	A	3	1375.0	1374.9	1378	4	14.8	15	3
M9	A	4	1375.2	1375.1	1378	4	14.7	15	3
M9	A	5	1375.2	1375.2	1378	4	14.7	15	3
M9	A	6	1375.3	1375.3	1378	4	14.7	15	3
M9	A	7	1375.4	1375.5	1378	4	14.7	15	3
M9	A	8	1375.5	1375.6	1378	4	14.7	15	3
M9	A	9	1375.5	1375.6	1378	4	14.7	15	3
M9	A	10	1375.5	1375.6	1378	4	14.7	15	3
M9	A	11	1375.5	1375.6	1378	4	14.8	15	3
M9	A	12	1375.6	1375.7	1378	4	14.8	15	3
M9	A	13	1375.5	1375.6	1378	4	14.9	15	3
M9	A	14	1375.5	1375.5	1378	4	14.9	15	3
M9	A	15	1375.5	1375.4	1378	4	15.0	15	3
M9	A	16	1375.4	1375.2	1378	4	15.0	15	3

Table 9: ND filter transmission for M9

Band	E side	Detector	Measurement		ND filter	Theoretical ND trans
			ND trans	Stddev of ND		
M9	A	1	0.0030	0.0003	2.6	0.003
M9	A	2	0.0036	0.0004	2.6	0.003
M9	A	3	0.0033	0.0001	2.6	0.003
M9	A	4	0.0036	0.0003	2.6	0.003
M9	A	5	0.0033	0.0001	2.6	0.003
M9	A	6	0.0032	0.0006	2.6	0.003
M9	A	7	0.0032	0.0002	2.6	0.003
M9	A	8	0.0033	0.0004	2.6	0.003
M9	A	9	0.0033	0.0001	2.6	0.003
M9	A	10	0.0033	0.0002	2.6	0.003
M9	A	11	0.0034	0.0002	2.6	0.003
M9	A	12	0.0034	0.0003	2.6	0.003
M9	A	13	0.0032	0.0002	2.6	0.003
M9	A	14	0.0033	0.0002	2.6	0.003
M9	A	15	0.0033	0.0003	2.6	0.003
M9	A	16	0.0034	0.0004	2.6	0.003

Table 10: 1 % limits and IOOB for M9

Band	E side	Detector	Measurement		Specification		IOOB (%)	
			Lower 1% limit	Upper 1% limit	Lower 1% limit	Upper 1% limit	Measurement	Specification
M9	A	1	1361.1	1389.0	1351	1405	0.74	1.0
M9	A	2	1361.6	1389.2	1351	1405	0.70	1.0
M9	A	3	1361.5	1389.4	1351	1405	0.61	1.0
M9	A	4	1361.7	1389.6	1351	1405	0.61	1.0
M9	A	5	1361.7	1389.6	1351	1405	0.54	1.0
M9	A	6	1361.8	1389.8	1351	1405	0.54	1.0
M9	A	7	1361.9	1390.0	1351	1405	0.51	1.0
M9	A	8	1361.9	1390.1	1351	1405	0.53	1.0
M9	A	9	1361.9	1390.1	1351	1405	0.48	1.0
M9	A	10	1361.8	1390.2	1351	1405	0.50	1.0
M9	A	11	1361.7	1390.2	1351	1405	0.46	1.0
M9	A	12	1361.6	1390.5	1351	1405	0.48	1.0
M9	A	13	1361.5	1390.4	1351	1405	0.48	1.0
M9	A	14	1361.3	1390.4	1351	1405	0.51	1.0
M9	A	15	1361.1	1390.3	1351	1405	0.52	1.0
M9	A	16	1360.8	1390.3	1351	1405	0.55	1.0

Table 11: MODTRAN results for M9 and Terra MODIS band 26

Wavelength Shift	Radiance Shift (%)	
	M9	Band 26 Terra
-2.00	-0.02	4.77
-1.75	-0.02	4.08
-1.50	-0.02	3.42
-1.25	-0.02	2.78
-1.00	-0.02	2.17
-0.75	-0.01	1.59
-0.50	-0.01	1.04
-0.25	-0.01	0.51
0.00	0.00	0.00
0.25	0.01	-0.48
0.50	0.01	-0.94
0.75	0.02	-1.37
1.00	0.02	-1.79
1.25	0.02	-2.18
1.50	0.02	-2.55
1.75	0.02	-2.89
2.00	0.02	-3.22

Table 12: Center wavelength and bandwidth for M10

Band	E side	Detector	Measurement		Specification		Measurement	Specification	
			Center	Centroid	Center	Tolerance	Bandwidth	Bandwidth	Tolerance
M10	B	1	1599.4	1600.3	1610	14	58.8	60	9
M10	B	2	1599.8	1600.6	1610	14	59.0	60	9
M10	B	3	1599.8	1600.7	1610	14	58.9	60	9
M10	B	4	1600.2	1600.9	1610	14	59.1	60	9
M10	B	5	1600.3	1601.1	1610	14	59.0	60	9
M10	B	6	1600.7	1601.4	1610	14	59.2	60	9
M10	B	7	1600.8	1601.6	1610	14	59.2	60	9
M10	B	8	1601.1	1601.8	1610	14	59.4	60	9
M10	B	9	1601.3	1602.1	1610	14	59.4	60	9
M10	B	10	1601.5	1602.1	1610	14	59.7	60	9
M10	B	11	1601.7	1602.4	1610	14	59.5	60	9
M10	B	12	1601.8	1602.4	1610	14	59.8	60	9
M10	B	13	1601.8	1602.5	1610	14	59.8	60	9
M10	B	14	1601.8	1602.4	1610	14	60.2	60	9
M10	B	15	1601.9	1602.5	1610	14	60.0	60	9
M10	B	16	1601.9	1602.4	1610	14	60.4	60	9

Table 13: ND filter transmission for M10

Band	E side	Detector	Measurement		ND filter	Theoretical ND trans
			ND trans	Stddev of ND		
M10	B	1	0.0181	0.0008	1.8	0.016
M10	B	2	0.0184	0.0004	1.8	0.016
M10	B	3	0.0196	0.0012	1.8	0.016
M10	B	4	0.0176	0.0016	1.8	0.016
M10	B	5	0.0199	0.0011	1.8	0.016
M10	B	6	0.0187	0.0004	1.8	0.016
M10	B	7	0.0190	0.0007	1.8	0.016
M10	B	8	0.0177	0.0015	1.8	0.016
M10	B	9	0.0198	0.0011	1.8	0.016
M10	B	10	0.0183	0.0010	1.8	0.016
M10	B	11	0.0191	0.0009	1.8	0.016
M10	B	12	0.0173	0.0010	1.8	0.016
M10	B	13	0.0187	0.0007	1.8	0.016
M10	B	14	0.0181	0.0011	1.8	0.016
M10	B	15	0.0186	0.0008	1.8	0.016
M10	B	16	0.0186	0.0012	1.8	0.016

Table 14: 1 % limits and IOOB for M10

Band	E side	Detector	Measurement		Specification		IOOB (%)	
			Lower 1% limit	Upper 1% limit	Lower 1% limit	Upper 1% limit	Measurement	Specification
M10	B	1	1541.0	1662.1	1509	1709	0.48	0.7
M10	B	2	1541.3	1662.7	1509	1709	0.48	0.7
M10	B	3	1541.5	1662.6	1509	1709	0.49	0.7
M10	B	4	1541.8	1663.2	1509	1709	0.47	0.7
M10	B	5	1541.8	1663.3	1509	1709	0.50	0.7
M10	B	6	1542.3	1663.9	1509	1709	0.48	0.7
M10	B	7	1542.4	1664.0	1509	1709	0.48	0.7
M10	B	8	1542.7	1664.7	1509	1709	0.46	0.7
M10	B	9	1542.8	1664.9	1509	1709	0.48	0.7
M10	B	10	1543.0	1665.2	1509	1709	0.46	0.7
M10	B	11	1543.1	1665.5	1509	1709	0.48	0.7
M10	B	12	1543.1	1665.6	1509	1709	0.45	0.7
M10	B	13	1543.0	1665.8	1509	1709	0.47	0.7
M10	B	14	1542.9	1666.0	1509	1709	0.46	0.7
M10	B	15	1542.9	1666.2	1509	1709	0.48	0.7
M10	B	16	1542.6	1666.4	1509	1709	0.47	0.7

Table 15: Center wavelength and bandwidth for M11

Band	E side	Detector	Measurement		Specification		Measurement	Specification	
			Center	Centroid	Center	Tolerance	Bandwidth	Bandwidth	Tolerance
M11	B	1	2255.6	2255.9	2250	13	45.0	50	6
M11	B	2	2256.6	2256.8	2250	13	46.4	50	6
M11	B	3	2255.6	2255.6	2250	13	45.6	50	6
M11	B	4	2257.1	2257.3	2250	13	46.4	50	6
M11	B	5	2256.3	2256.6	2250	13	45.3	50	6
M11	B	6	2257.1	2257.3	2250	13	46.5	50	6
M11	B	7	2256.7	2256.9	2250	13	45.5	50	6
M11	B	8	2257.5	2257.8	2250	13	46.4	50	6
M11	B	9	2257.0	2257.1	2250	13	46.0	50	6
M11	B	10	2257.8	2258.0	2250	13	47.0	50	6
M11	B	11	2257.2	2257.4	2250	13	46.2	50	6
M11	B	12	2258.0	2258.2	2250	13	46.8	50	6
M11	B	13	2257.2	2257.3	2250	13	46.4	50	6
M11	B	14	2257.7	2258.0	2250	13	47.0	50	6
M11	B	15	2256.6	2256.9	2250	13	46.2	50	6
M11	B	16	2257.4	2258.0	2250	13	46.5	50	6

Table 16: ND filter transmission for M11

Band	E side	Detector	Measurement		ND filter	Theoretical ND trans
			ND trans	Stddev of ND		
M11	B	1	0.0451	0.0022	1.3	0.050
M11	B	2	0.0553	0.0010	1.2	0.063
M11	B	3	0.0435	0.0017	1.3	0.050
M11	B	4	0.0546	0.0011	1.2	0.063
M11	B	5	0.0433	0.0013	1.3	0.050
M11	B	6	0.0553	0.0014	1.2	0.063
M11	B	7	0.0447	0.0027	1.3	0.050
M11	B	8	0.0558	0.0020	1.2	0.063
M11	B	9	0.0425	0.0017	1.3	0.050
M11	B	10	0.0542	0.0014	1.2	0.063
M11	B	11	0.0447	0.0026	1.3	0.050
M11	B	12	0.0554	0.0014	1.2	0.063
M11	B	13	0.0436	0.0025	1.3	0.050
M11	B	14	0.0570	0.0020	1.2	0.063
M11	B	15	0.0415	0.0017	1.3	0.050
M11	B	16	0.0550	0.0010	1.2	0.063

Table 17: 1 % limits and IOOB for M11

Band	E side	Detector	Measurement		Specification		IOOB (%)	
			Lower 1% limit	Upper 1% limit	Lower 1% limit	Upper 1% limit	Measurement	Specification
M11	B	1	2211.0	2301.3	2167	2333	0.46	1.0
M11	B	2	2211.1	2302.7	2167	2333	0.42	1.0
M11	B	3	2210.7	2300.3	2167	2333	0.44	1.0
M11	B	4	2211.6	2303.7	2167	2333	0.42	1.0
M11	B	5	2211.7	2301.9	2167	2333	0.44	1.0
M11	B	6	2211.6	2303.5	2167	2333	0.42	1.0
M11	B	7	2211.9	2302.3	2167	2333	0.44	1.0
M11	B	8	2212.0	2304.4	2167	2333	0.42	1.0
M11	B	9	2211.9	2302.5	2167	2333	0.43	1.0
M11	B	10	2211.9	2304.7	2167	2333	0.41	1.0
M11	B	11	2211.8	2302.9	2167	2333	0.43	1.0
M11	B	12	2212.1	2305.2	2167	2333	0.42	1.0
M11	B	13	2211.7	2303.0	2167	2333	0.43	1.0
M11	B	14	2211.6	2305.1	2167	2333	0.42	1.0
M11	B	15	2211.1	2303.1	2167	2333	0.43	1.0
M11	B	16	2211.4	2305.7	2167	2333	0.42	1.0

Table 18: Center wavelength and bandwidth for M12

Band	E side	Detector	Measurement		Specification		Measurement	Specification	
			Center	Centroid	Center	Tolerance	Bandwidth	Bandwidth	Tolerance
M12	B	1	3694.5	3695.4	3700	32	191.8	180	20
M12	B	2	3693.9	3696.1	3700	32	194.4	180	20
M12	B	3	3693.6	3695.8	3700	32	195.5	180	20
M12	B	4	3694.2	3696.1	3700	32	193.4	180	20
M12	B	5	3694.0	3696.0	3700	32	194.1	180	20
M12	B	6	3694.7	3696.7	3700	32	192.8	180	20
M12	B	7	3694.5	3696.8	3700	32	193.2	180	20
M12	B	8	3695.2	3697.1	3700	32	192.4	180	20
M12	B	9	3694.7	3696.9	3700	32	192.6	180	20
M12	B	10	3695.4	3697.3	3700	32	192.1	180	20
M12	B	11	3695.0	3697.1	3700	32	192.3	180	20
M12	B	12	3695.3	3697.1	3700	32	192.0	180	20
M12	B	13	3694.6	3696.8	3700	32	192.3	180	20
M12	B	14	3695.1	3697.0	3700	32	192.3	180	20
M12	B	15	3694.6	3696.8	3700	32	192.2	180	20
M12	B	16	3694.6	3696.6	3700	32	192.5	180	20

Table 19: ND filter transmission for M12

Band	E side	Detector	Measurement		ND filter	Theoretical ND trans
			ND trans	Stddev of ND		
M12	B	1	0.0268	0.0036	1.6	0.025
M12	B	2	0.0284	0.0014	1.6	0.025
M12	B	3	0.0271	0.0028	1.6	0.025
M12	B	4	0.0266	0.0013	1.6	0.025
M12	B	5	0.0268	0.0022	1.6	0.025
M12	B	6	0.0281	0.0012	1.6	0.025
M12	B	7	0.0283	0.0025	1.6	0.025
M12	B	8	0.0269	0.0011	1.6	0.025
M12	B	9	0.0260	0.0028	1.6	0.025
M12	B	10	0.0269	0.0013	1.6	0.025
M12	B	11	0.0267	0.0025	1.6	0.025
M12	B	12	0.0281	0.0015	1.6	0.025
M12	B	13	0.0279	0.0027	1.6	0.025
M12	B	14	0.0287	0.0015	1.6	0.025
M12	B	15	0.0280	0.0023	1.6	0.025
M12	B	16	0.0295	0.0012	1.6	0.025

Table 20: 1 % limits and IOOB for M12

Band	E side	Detector	Measurement		Specification		IOOB (%)	
			Lower 1% limit	Upper 1% limit	Lower 1% limit	Upper 1% limit	Measurement	Specification
M12	B	1	3517.3	3891.8	3410	3990	0.36	1.1
M12	B	2	3512.9	3890.8	3410	3990	0.38	1.1
M12	B	3	3511.3	3892.1	3410	3990	0.38	1.1
M12	B	4	3514.0	3890.0	3410	3990	0.37	1.1
M12	B	5	3513.1	3890.6	3410	3990	0.37	1.1
M12	B	6	3515.6	3889.0	3410	3990	0.38	1.1
M12	B	7	3514.8	3890.2	3410	3990	0.38	1.1
M12	B	8	3516.5	3889.8	3410	3990	0.37	1.1
M12	B	9	3515.5	3890.3	3410	3990	0.37	1.1
M12	B	10	3517.3	3889.9	3410	3990	0.37	1.1
M12	B	11	3516.3	3890.2	3410	3990	0.38	1.1
M12	B	12	3517.4	3889.5	3410	3990	0.38	1.1
M12	B	13	3516.3	3889.6	3410	3990	0.38	1.1
M12	B	14	3517.0	3889.7	3410	3990	0.38	1.1
M12	B	15	3516.2	3890.1	3410	3990	0.38	1.1
M12	B	16	3516.4	3889.9	3410	3990	0.38	1.1

Table 21: Center wavelength and bandwidth for M13

Band	E side	Detector	Measurement		Specification		Measurement	Specification	
			Center	Centroid	Center	Tolerance	Bandwidth	Bandwidth	Tolerance
M13	A	1	4065.0	4065.6	4050	34	158.6	155	20
M13	A	2	4065.3	4066.1	4050	34	158.3	155	20
M13	A	3	4065.7	4066.5	4050	34	158.9	155	20
M13	A	4	4065.3	4066.0	4050	34	158.5	155	20
M13	A	5	4065.9	4066.4	4050	34	158.1	155	20
M13	A	6	4065.5	4065.9	4050	34	158.1	155	20
M13	A	7	4066.2	4066.6	4050	34	157.0	155	20
M13	A	8	4065.8	4066.4	4050	34	158.0	155	20
M13	A	9	4066.3	4066.8	4050	34	156.6	155	20
M13	A	10	4066.0	4066.5	4050	34	158.0	155	20
M13	A	11	4066.5	4067.0	4050	34	156.4	155	20
M13	A	12	4065.6	4066.2	4050	34	157.9	155	20
M13	A	13	4066.3	4066.8	4050	34	156.2	155	20
M13	A	14	4065.3	4066.0	4050	34	157.9	155	20
M13	A	15	4065.9	4066.7	4050	34	156.6	155	20
M13	A	16	4065.1	4066.1	4050	34	158.0	155	20

Table 22: ND filter transmission for M13

Band	E side	Detector	Measurement		ND filter	Theoretical ND trans
			ND trans	Stddev of ND		
M13	A	1	0.0627	0.0079	1.3	0.050
M13	A	2	0.0547	0.0057	1.3	0.050
M13	A	3	0.0632	0.0060	1.3	0.050
M13	A	4	0.0508	0.0017	1.3	0.050
M13	A	5	0.0607	0.0042	1.3	0.050
M13	A	6	0.0529	0.0022	1.3	0.050
M13	A	7	0.0618	0.0043	1.3	0.050
M13	A	8	0.0517	0.0017	1.3	0.050
M13	A	9	0.0612	0.0037	1.3	0.050
M13	A	10	0.0510	0.0022	1.3	0.050
M13	A	11	0.0625	0.0033	1.3	0.050
M13	A	12	0.0521	0.0007	1.3	0.050
M13	A	13	0.0641	0.0045	1.3	0.050
M13	A	14	0.0542	0.0025	1.3	0.050
M13	A	15	0.0654	0.0066	1.3	0.050
M13	A	16	0.0521	0.0016	1.3	0.050

Table 23: 1 % limits and IOOB for M13

Band	E side	Detector	Measurement		Specification		IOOB (%)	
			Lower 1% limit	Upper 1% limit	Lower 1% limit	Upper 1% limit	Measurement	Specification
M13	A	1	3898.4	4213.1	3790	4310	0.42	1.3
M13	A	2	3899.7	4213.0	3790	4310	0.42	1.3
M13	A	3	3898.9	4213.3	3790	4310	0.41	1.3
M13	A	4	3899.7	4213.1	3790	4310	0.42	1.3
M13	A	5	3899.9	4213.3	3790	4310	0.39	1.3
M13	A	6	3900.1	4212.9	3790	4310	0.40	1.3
M13	A	7	3901.6	4212.9	3790	4310	0.39	1.3
M13	A	8	3900.8	4213.7	3790	4310	0.43	1.3
M13	A	9	3902.2	4213.6	3790	4310	0.40	1.3
M13	A	10	3901.1	4213.8	3790	4310	0.42	1.3
M13	A	11	3902.7	4213.8	3790	4310	0.41	1.3
M13	A	12	3900.8	4214.1	3790	4310	0.44	1.3
M13	A	13	3902.5	4214.0	3790	4310	0.43	1.3
M13	A	14	3900.3	4214.6	3790	4310	0.47	1.3
M13	A	15	3901.9	4214.3	3790	4310	0.45	1.3
M13	A	16	3900.0	4214.8	3790	4310	0.45	1.3

Table 24: Center wavelength and bandwidth for I3 SS1

Band	E side	Detector	Measurement		Specification		Measurement	Specification	
			Center	Centroid	Center	Tolerance	Bandwidth	Bandwidth	Tolerance
I3	A	1	1599.2	1600.3	1610	14	58.4	60	9
I3	A	2	1599.4	1600.5	1610	14	58.5	60	9
I3	A	3	1599.5	1600.5	1610	14	58.5	60	9
I3	A	4	1599.7	1600.8	1610	14	58.6	60	9
I3	A	5	1599.7	1600.7	1610	14	58.5	60	9
I3	A	6	1600.0	1601.0	1610	14	58.7	60	9
I3	A	7	1600.0	1601.0	1610	14	58.5	60	9
I3	A	8	1600.2	1601.2	1610	14	58.8	60	9
I3	A	9	1600.3	1601.2	1610	14	58.6	60	9
I3	A	10	1600.4	1601.4	1610	14	58.8	60	9
I3	A	11	1600.5	1601.4	1610	14	58.7	60	9
I3	A	12	1600.8	1601.8	1610	14	58.8	60	9
I3	A	13	1600.9	1601.8	1610	14	58.8	60	9
I3	A	14	1601.0	1602.0	1610	14	58.8	60	9
I3	A	15	1601.0	1601.9	1610	14	58.8	60	9
I3	A	16	1601.1	1602.0	1610	14	58.9	60	9

Table 25: Center wavelength and bandwidth for I3 SS1

Band	E side	Detector	Measurement		Specification		Measurement	Specification	
			Center	Centroid	Center	Tolerance	Bandwidth	Bandwidth	Tolerance
I3	A	17	1601.2	1602.1	1610	14	59.0	60	9
I3	A	18	1601.4	1602.3	1610	14	59.0	60	9
I3	A	19	1601.5	1602.3	1610	14	59.1	60	9
I3	A	20	1601.7	1602.5	1610	14	59.0	60	9
I3	A	21	1601.7	1602.5	1610	14	59.1	60	9
I3	A	22	1601.8	1602.6	1610	14	59.2	60	9
I3	A	23	1601.8	1602.5	1610	14	59.2	60	9
I3	A	24	1601.9	1602.6	1610	14	59.2	60	9
I3	A	25	1601.8	1602.5	1610	14	59.3	60	9
I3	A	26	1602.0	1602.8	1610	14	59.4	60	9
I3	A	27	1602.0	1602.7	1610	14	59.4	60	9
I3	A	28	1602.0	1602.8	1610	14	59.4	60	9
I3	A	29	1602.0	1602.7	1610	14	59.5	60	9
I3	A	30	1602.2	1602.9	1610	14	59.4	60	9
I3	A	31	1602.0	1602.7	1610	14	59.6	60	9
I3	A	32	1602.0	1602.8	1610	14	59.6	60	9

Table 26: ND filter transmission for I3 SS1

Band	E side	Detector	Measurement		ND filter	Theoretical ND trans
			ND trans	Stddev of ND		
I3	A	1	0.0216	0.0008	1.7	0.020
I3	A	2	0.0120	0.0006	2.0	0.010
I3	A	3	0.0217	0.0006	1.7	0.020
I3	A	4	0.0117	0.0005	2.0	0.010
I3	A	5	0.0212	0.0011	1.7	0.020
I3	A	6	0.0119	0.0008	2.0	0.010
I3	A	7	0.0216	0.0005	1.7	0.020
I3	A	8	0.0119	0.0004	2.0	0.010
I3	A	9	0.0216	0.0005	1.7	0.020
I3	A	10	0.0117	0.0004	2.0	0.010
I3	A	11	0.0209	0.0010	1.7	0.020
I3	A	12	0.0115	0.0003	2.0	0.010
I3	A	13	0.0213	0.0005	1.7	0.020
I3	A	14	0.0116	0.0004	2.0	0.010
I3	A	15	0.0212	0.0008	1.7	0.020
I3	A	16	0.0117	0.0005	2.0	0.010

Table 27: ND filter transmission for I3 SS1

Band	E side	Detector	Measurement		ND filter	Theoretical ND trans
			ND trans	Stddev of ND		
I3	A	17	0.0214	0.0005	1.7	0.020
I3	A	18	0.0118	0.0006	2.0	0.010
I3	A	19	0.0209	0.0007	1.7	0.020
I3	A	20	0.0116	0.0003	2.0	0.010
I3	A	21	0.0211	0.0005	1.7	0.020
I3	A	22	0.0116	0.0004	2.0	0.010
I3	A	23	0.0214	0.0012	1.7	0.020
I3	A	24	0.0114	0.0004	2.0	0.010
I3	A	25	0.0212	0.0006	1.7	0.020
I3	A	26	0.0114	0.0003	2.0	0.010
I3	A	27	0.0212	0.0007	1.7	0.020
I3	A	28	0.0117	0.0007	2.0	0.010
I3	A	29	0.0201	0.0010	1.7	0.020
I3	A	30	0.0110	0.0006	2.0	0.010
I3	A	31	0.0192	0.0008	1.7	0.020
I3	A	32	0.0108	0.0008	2.0	0.010

Table 28 1 % limits and IOOB for I3 SS1

Band	E side	Detector	Measurement		Specification		IOOB (%)	
			Lower 1% limit	Upper 1% limit	Lower 1% limit	Upper 1% limit	Measurement	Specification
I3	A	1	1541.1	1661.6	1509	1709	0.51	0.7
I3	A	2	1541.3	1661.7	1509	1709	0.53	0.7
I3	A	3	1541.3	1661.9	1509	1709	0.51	0.7
I3	A	4	1541.6	1662.1	1509	1709	0.51	0.7
I3	A	5	1541.5	1662.1	1509	1709	0.51	0.7
I3	A	6	1542.0	1662.5	1509	1709	0.51	0.7
I3	A	7	1541.8	1662.4	1509	1709	0.51	0.7
I3	A	8	1542.2	1662.7	1509	1709	0.50	0.7
I3	A	9	1542.1	1662.8	1509	1709	0.51	0.7
I3	A	10	1542.3	1663.0	1509	1709	0.51	0.7
I3	A	11	1542.3	1663.1	1509	1709	0.51	0.7
I3	A	12	1542.8	1663.4	1509	1709	0.51	0.7
I3	A	13	1542.7	1663.6	1509	1709	0.51	0.7
I3	A	14	1543.1	1663.7	1509	1709	0.51	0.7
I3	A	15	1542.8	1663.9	1509	1709	0.51	0.7
I3	A	16	1543.1	1663.9	1509	1709	0.50	0.7

Table 29: 1 % limits and IOOB for I3 SS1

Band	E side	Detector	Measurement		Specification		IOOB (%)	
			Lower 1% limit	Upper 1% limit	Lower 1% limit	Upper 1% limit	Measurement	Specification
I3	A	17	1543.1	1664.3	1509	1709	0.51	0.7
I3	A	18	1543.4	1664.4	1509	1709	0.51	0.7
I3	A	19	1543.4	1664.7	1509	1709	0.50	0.7
I3	A	20	1543.5	1665.0	1509	1709	0.49	0.7
I3	A	21	1543.5	1665.0	1509	1709	0.49	0.7
I3	A	22	1543.5	1665.1	1509	1709	0.49	0.7
I3	A	23	1543.4	1665.2	1509	1709	0.49	0.7
I3	A	24	1543.5	1665.1	1509	1709	0.49	0.7
I3	A	25	1543.2	1665.4	1509	1709	0.50	0.7
I3	A	26	1543.6	1665.5	1509	1709	0.50	0.7
I3	A	27	1543.5	1665.6	1509	1709	0.50	0.7
I3	A	28	1543.5	1665.6	1509	1709	0.50	0.7
I3	A	29	1543.5	1665.8	1509	1709	0.49	0.7
I3	A	30	1543.4	1665.7	1509	1709	0.50	0.7
I3	A	31	1543.1	1666.0	1509	1709	0.49	0.7
I3	A	32	1543.2	1665.8	1509	1709	0.49	0.7

Table 30: Center wavelength and bandwidth for I4 SS1

Band	E side	Detector	Measurement		Specification		Measurement	Specification	
			Center	Centroid	Center	Tolerance	Bandwidth	Bandwidth	Tolerance
I4	B	1	3740.8	3746.0	3740	40	387.0	380	30
I4	B	2	3743.2	3749.1	3740	40	386.8	380	30
I4	B	3	3740.5	3745.8	3740	40	387.6	380	30
I4	B	4	3743.6	3749.4	3740	40	387.1	380	30
I4	B	5	3740.9	3745.8	3740	40	387.9	380	30
I4	B	6	3743.8	3749.3	3740	40	387.1	380	30
I4	B	7	3741.2	3746.7	3740	40	386.9	380	30
I4	B	8	3744.1	3749.9	3740	40	387.3	380	30
I4	B	9	3741.2	3745.5	3740	40	387.0	380	30
I4	B	10	3744.7	3750.5	3740	40	387.0	380	30
I4	B	11	3741.6	3747.1	3740	40	385.1	380	30
I4	B	12	3745.1	3750.2	3740	40	386.0	380	30
I4	B	13	3742.3	3747.6	3740	40	386.7	380	30
I4	B	14	3745.2	3750.1	3740	40	385.8	380	30
I4	B	15	3743.0	3748.0	3740	40	386.5	380	30
I4	B	16	3745.6	3751.0	3740	40	385.6	380	30

Table 31: Center wavelength and bandwidth for I4 SS1

Band	E side	Detector	Measurement		Specification		Measurement	Specification	
			Center	Centroid	Center	Tolerance	Bandwidth	Bandwidth	Tolerance
I4	B	17	3743.4	3748.4	3740	40	385.6	380	30
I4	B	18	3745.2	3750.1	3740	40	386.0	380	30
I4	B	19	3743.5	3748.4	3740	40	385.5	380	30
I4	B	20	3745.5	3751.1	3740	40	385.1	380	30
I4	B	21	3743.7	3748.6	3740	40	384.8	380	30
I4	B	22	3745.2	3750.3	3740	40	385.2	380	30
I4	B	23	3743.4	3748.1	3740	40	385.3	380	30
I4	B	24	3745.2	3750.4	3740	40	385.3	380	30
I4	B	25	3743.3	3748.2	3740	40	385.4	380	30
I4	B	26	3744.8	3750.0	3740	40	385.2	380	30
I4	B	27	3743.3	3748.3	3740	40	385.0	380	30
I4	B	28	3744.8	3750.0	3740	40	385.1	380	30
I4	B	29	3743.3	3748.4	3740	40	384.7	380	30
I4	B	30	3744.3	3749.5	3740	40	385.4	380	30
I4	B	31	3742.9	3748.2	3740	40	383.9	380	30
I4	B	32	3743.1	3748.7	3740	40	384.9	380	30

Table 32: ND filter transmission for I4 SS1

Band	E side	Detector	Measurement		ND filter	Theoretical ND trans
			ND trans	Stddev of ND		
I4	B	1	0.0587	0.0022	1.3	0.050
I4	B	2	0.1035	0.0068	1.0	0.100
I4	B	3	0.0579	0.0001	1.3	0.050
I4	B	4	0.1021	0.0087	1.0	0.100
I4	B	5	0.0569	0.0012	1.3	0.050
I4	B	6	0.1022	0.0065	1.0	0.100
I4	B	7	0.0565	0.0012	1.3	0.050
I4	B	8	0.1012	0.0063	1.0	0.100
I4	B	9	0.0535	0.0013	1.3	0.050
I4	B	10	0.1018	0.0048	1.0	0.100
I4	B	11	0.0576	0.0005	1.3	0.050
I4	B	12	0.0992	0.0039	1.0	0.100
I4	B	13	0.0582	0.0010	1.3	0.050
I4	B	14	0.0957	0.0049	1.0	0.100
I4	B	15	0.0589	0.0004	1.3	0.050
I4	B	16	0.0981	0.0061	1.0	0.100

Table 33: ND filter transmission for I4 SS1

Band	E side	Detector	Measurement		ND filter	Theoretical ND trans
			ND trans	Stddev of ND		
I4	B	17	0.0564	0.0011	1.3	0.050
I4	B	18	0.0962	0.0057	1.0	0.100
I4	B	19	0.0557	0.0012	1.3	0.050
I4	B	20	0.0919	0.0050	1.0	0.100
I4	B	21	0.0557	0.0019	1.3	0.050
I4	B	22	0.0863	0.0052	1.0	0.100
I4	B	23	0.0579	0.0004	1.3	0.050
I4	B	24	0.0787	0.0036	1.0	0.100
I4	B	25	0.0582	0.0008	1.3	0.050
I4	B	26	0.0730	0.0027	1.0	0.100
I4	B	27	0.0582	0.0033	1.3	0.050
I4	B	28	0.0667	0.0020	1.0	0.100
I4	B	29	0.0591	0.0022	1.3	0.050
I4	B	30	0.0599	0.0040	1.0	0.100
I4	B	31	0.0593	0.0023	1.3	0.050
I4	B	32	0.0641	0.0045	1.0	0.100

Table 34: 1 % limits and IOOB for I4 SS1

Band	E side	Detector	Measurement		Specification		IOOB (%)	
			Lower 1% limit	Upper 1% limit	Lower 1% limit	Upper 1% limit	Measurement	Specification
I4	B	1	3470.1	4007.1	3340	4140	0.24	0.5
I4	B	2	3472.4	4008.6	3340	4140	0.25	0.5
I4	B	3	3469.2	4007.1	3340	4140	0.26	0.5
I4	B	4	3473.0	4009.1	3340	4140	0.25	0.5
I4	B	5	3469.8	4007.7	3340	4140	0.23	0.5
I4	B	6	3473.2	4009.3	3340	4140	0.24	0.5
I4	B	7	3470.8	4007.1	3340	4140	0.23	0.5
I4	B	8	3473.4	4010.1	3340	4140	0.23	0.5
I4	B	9	3470.4	4006.8	3340	4140	0.20	0.5
I4	B	10	3474.3	4010.2	3340	4140	0.23	0.5
I4	B	11	3472.0	4006.7	3340	4140	0.22	0.5
I4	B	12	3475.0	4010.0	3340	4140	0.25	0.5
I4	B	13	3471.8	4008.1	3340	4140	0.23	0.5
I4	B	14	3474.9	4009.9	3340	4140	0.23	0.5
I4	B	15	3472.5	4008.7	3340	4140	0.24	0.5
I4	B	16	3475.1	4010.4	3340	4140	0.23	0.5

Table 35: 1 % limits and IOOB for I4 SS1

Band	E side	Detector	Measurement		Specification		IOOB (%)	
			Lower 1% limit	Upper 1% limit	Lower 1% limit	Upper 1% limit	Measurement	Specification
I4	B	17	3473.1	4008.6	3340	4140	0.24	0.5
I4	B	18	3474.8	4010.3	3340	4140	0.23	0.5
I4	B	19	3473.1	4008.7	3340	4140	0.24	0.5
I4	B	20	3475.6	4010.0	3340	4140	0.24	0.5
I4	B	21	3473.0	4009.1	3340	4140	0.23	0.5
I4	B	22	3475.0	4010.1	3340	4140	0.24	0.5
I4	B	23	3472.5	4009.0	3340	4140	0.24	0.5
I4	B	24	3475.1	4010.5	3340	4140	0.24	0.5
I4	B	25	3472.6	4008.9	3340	4140	0.25	0.5
I4	B	26	3474.6	4010.0	3340	4140	0.23	0.5
I4	B	27	3472.5	4008.8	3340	4140	0.25	0.5
I4	B	28	3474.6	4010.0	3340	4140	0.25	0.5
I4	B	29	3472.1	4008.8	3340	4140	0.25	0.5
I4	B	30	3474.1	4009.6	3340	4140	0.24	0.5
I4	B	31	3472.4	4008.1	3340	4140	0.27	0.5
I4	B	32	3472.8	4008.6	3340	4140	0.32	0.5

Figure 1: Example of SpMA RSO used for M12

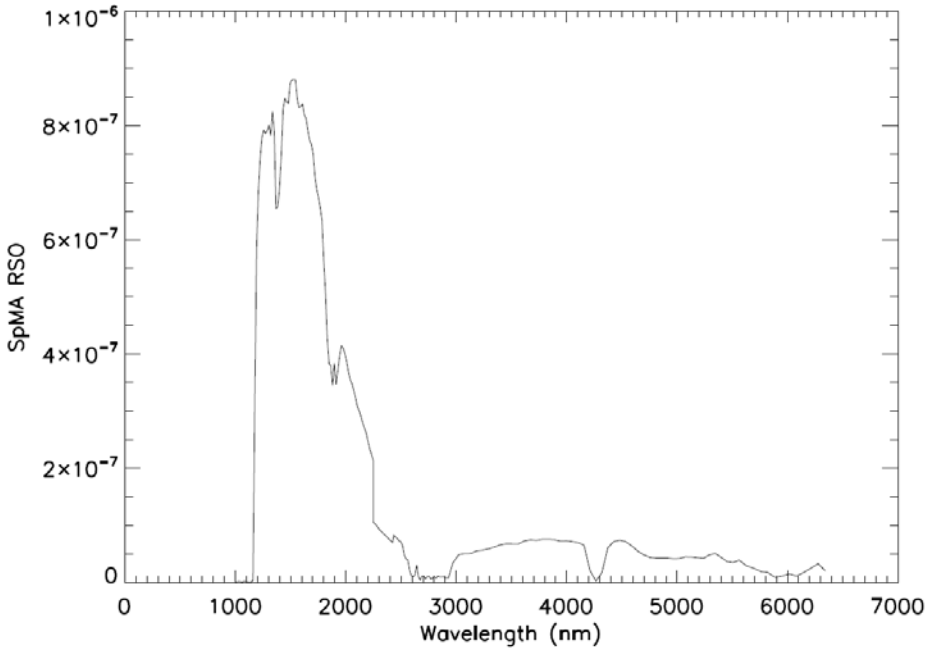

Figure 2: Spectral Characteristics

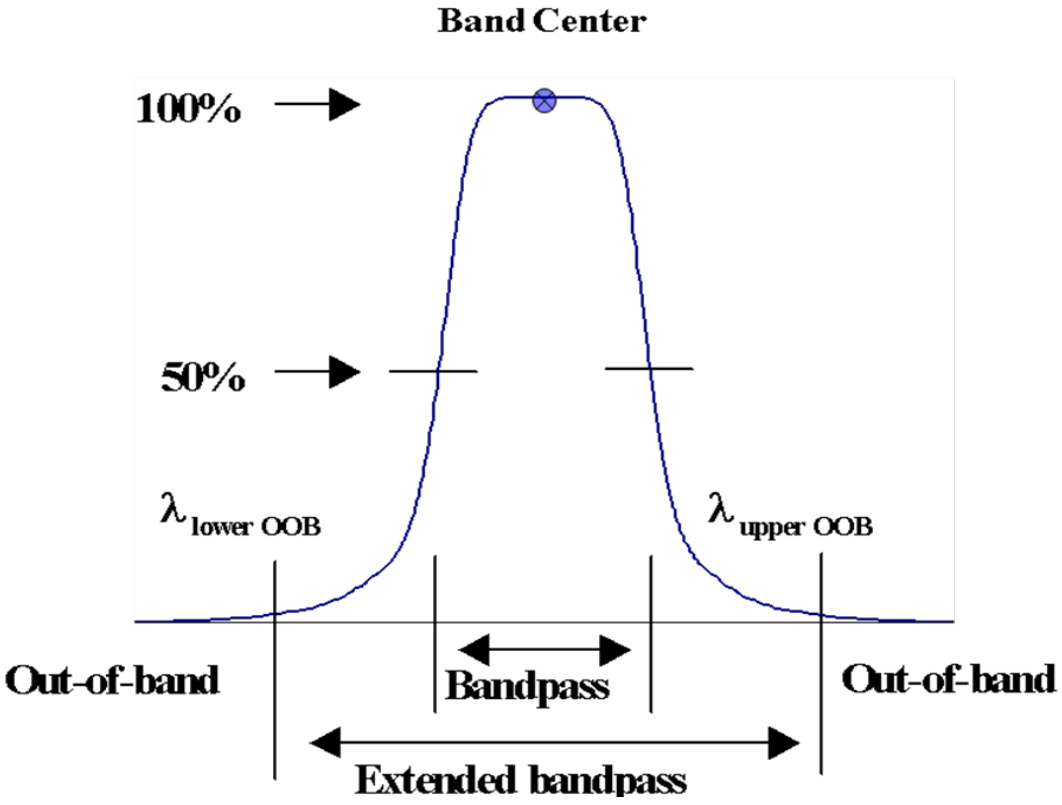

Figure 3: IB RSR for M8

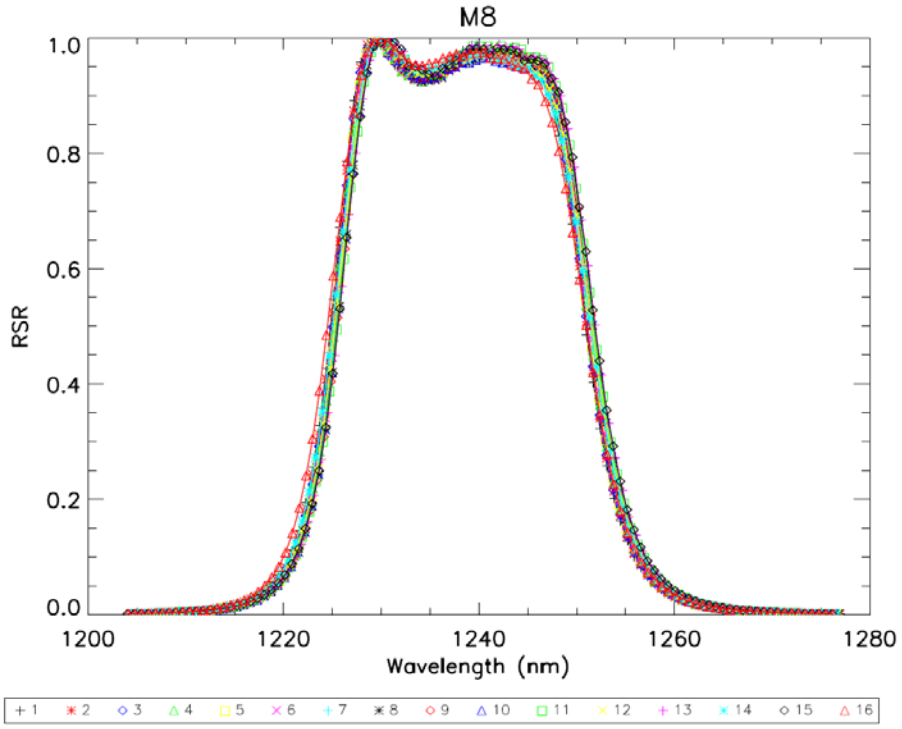

Figure 4: RSR for M8

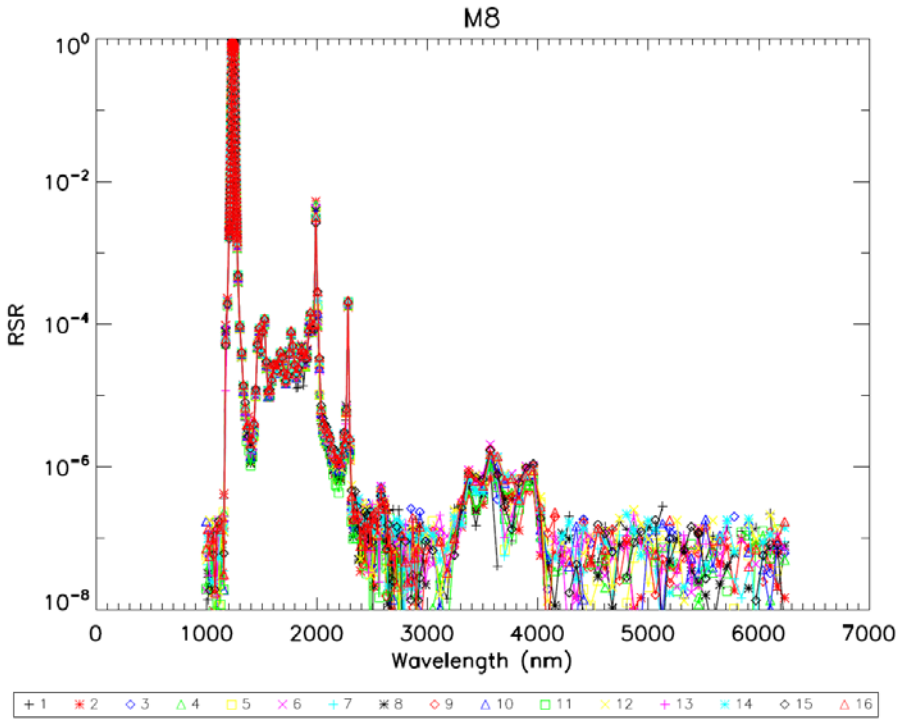

Figure 5: IB RSR for M9

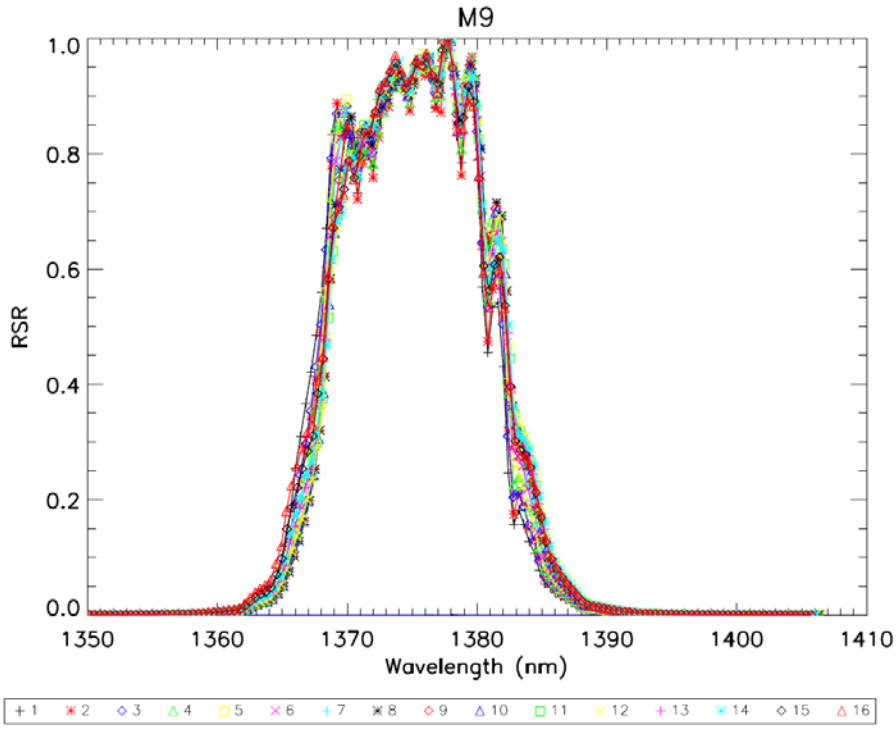

Figure 6: RSR for M9

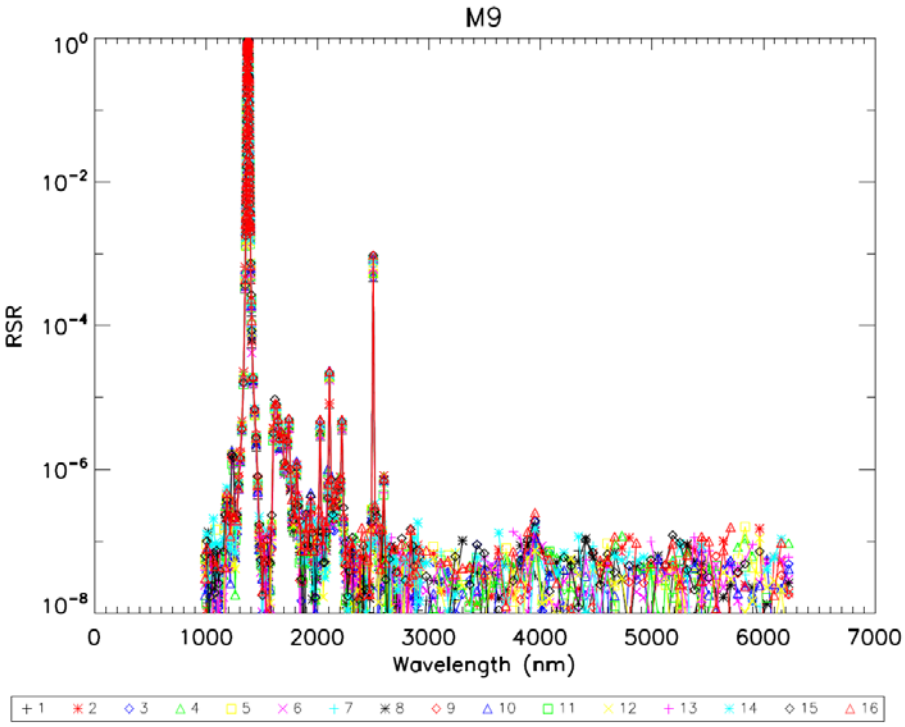

Figure 7: IB RSR for M10

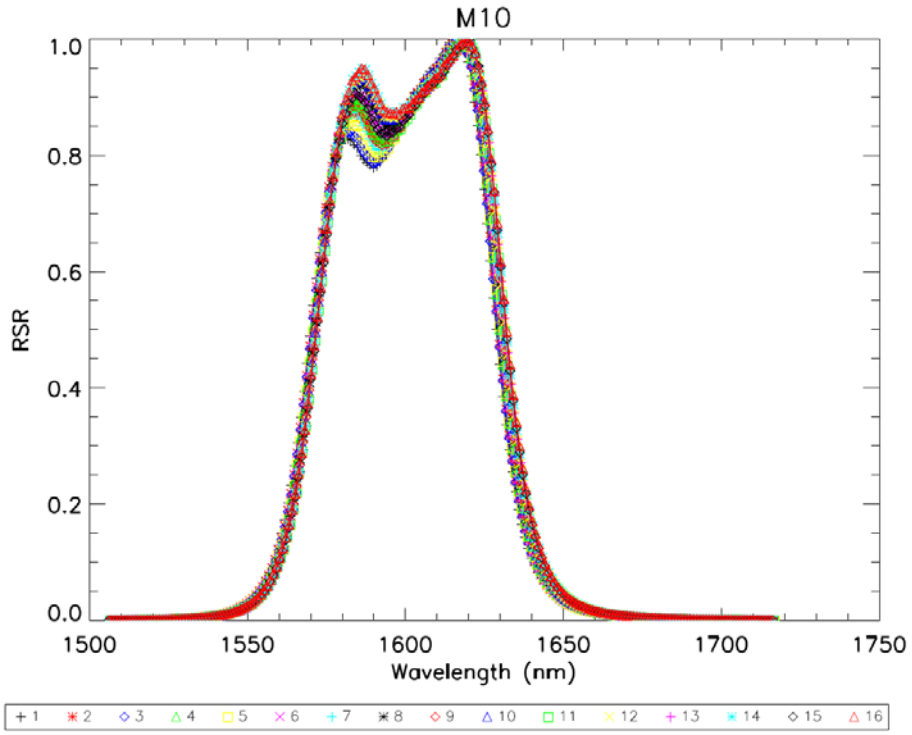

Figure 8: RSR for M10

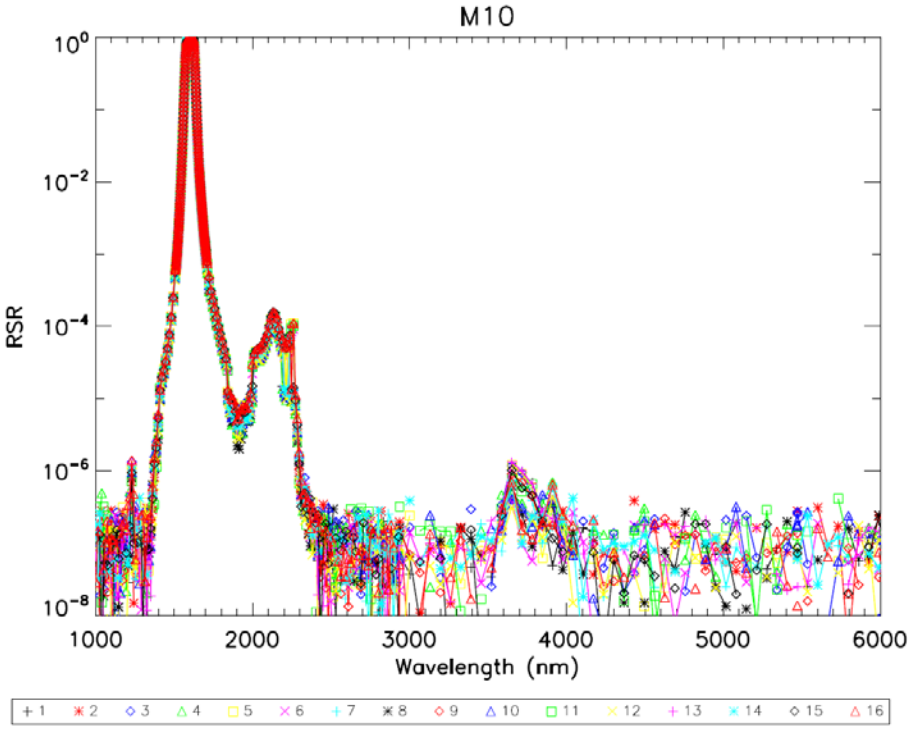

Figure 9: IB RSR for M11

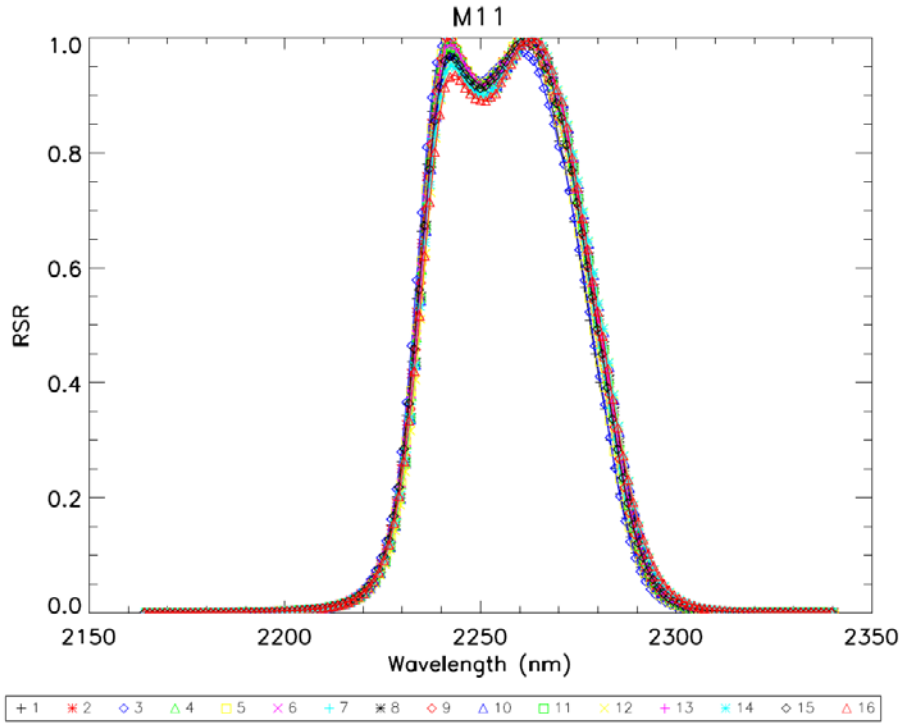

Figure 10: RSR for M11

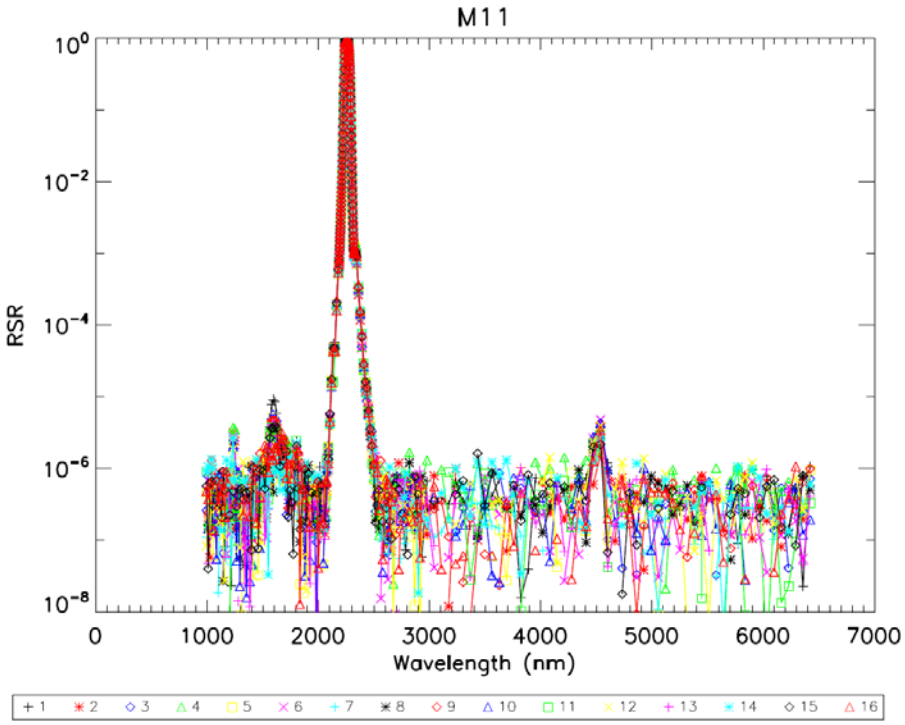

Figure 11: IB RSR for M12

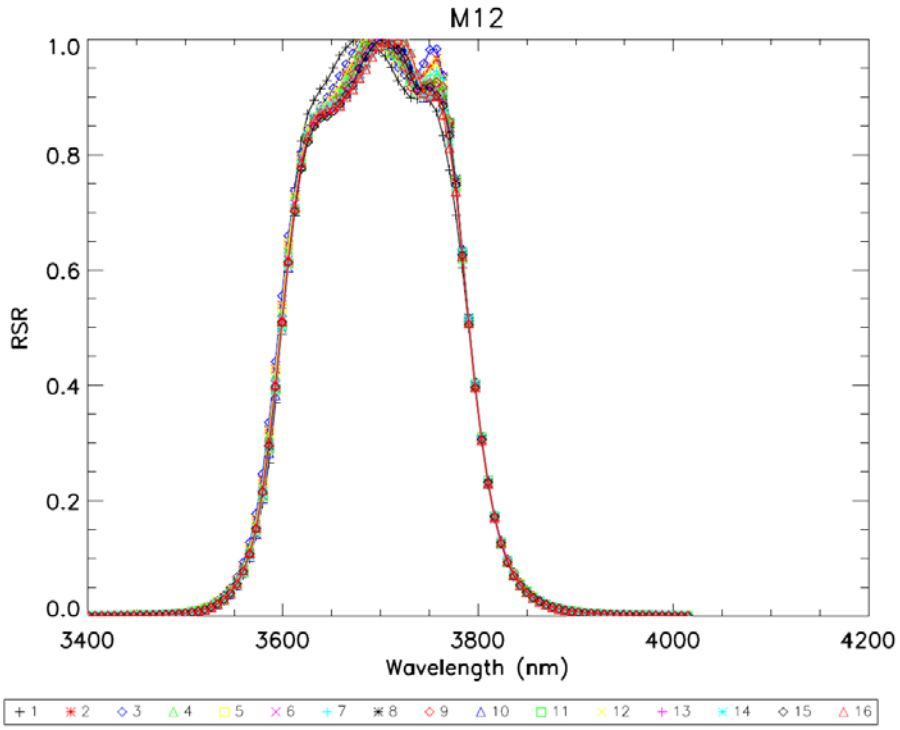

Figure 12: RSR for M12

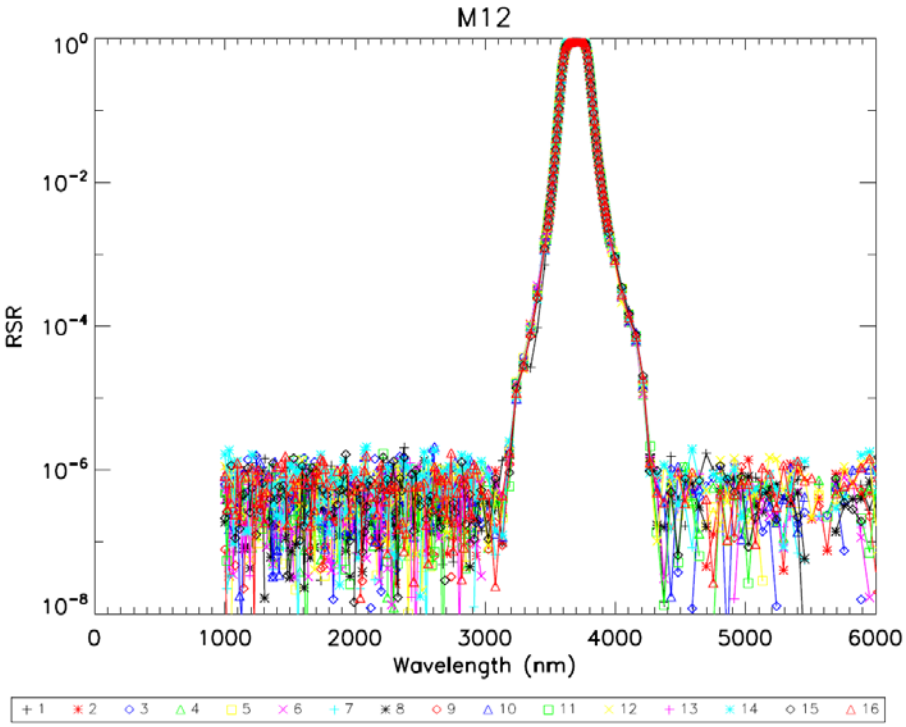

Figure 13: IB RSR for M13

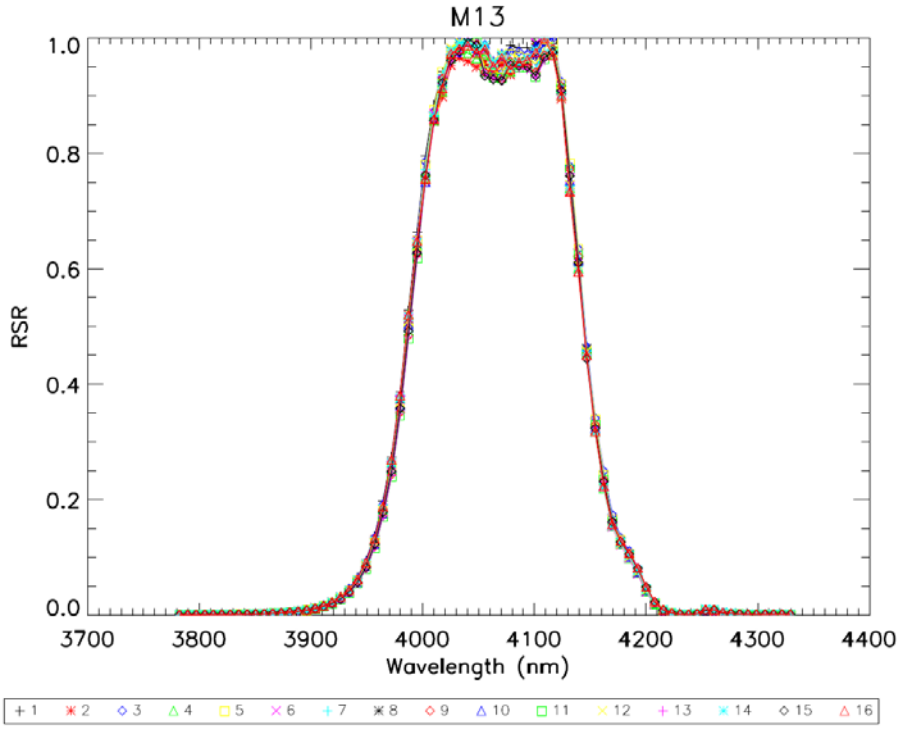

Figure 14: RSR for M13

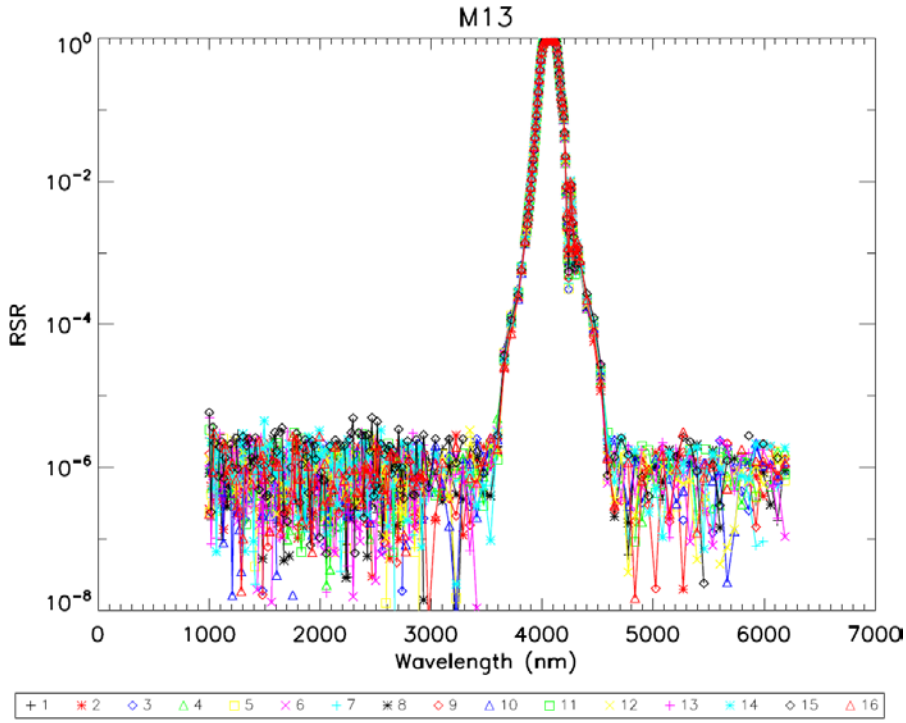

Figure 15: IB RSR for I3 SS1

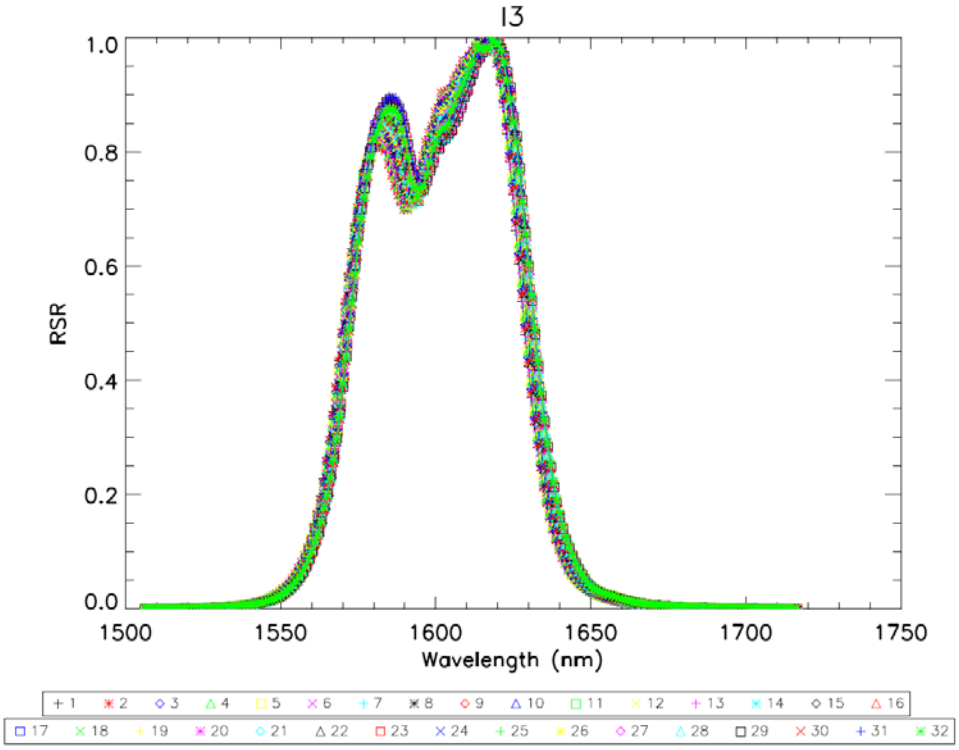

Figure 16: RSR for I3 SS1

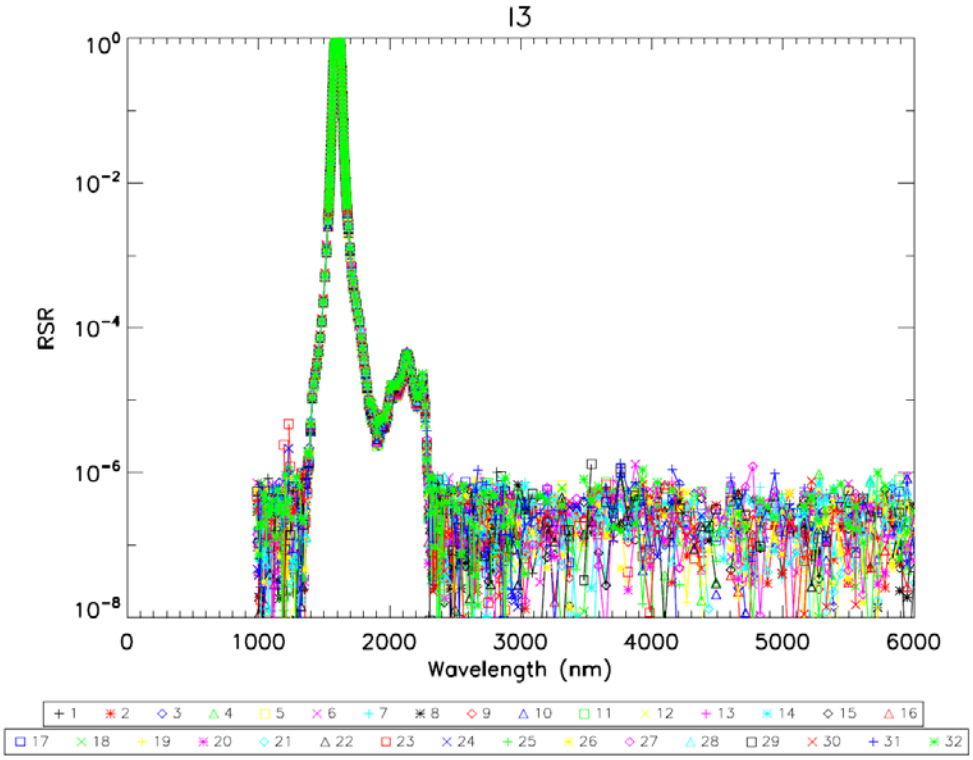

Figure 17: IB RSR for I4 SS1

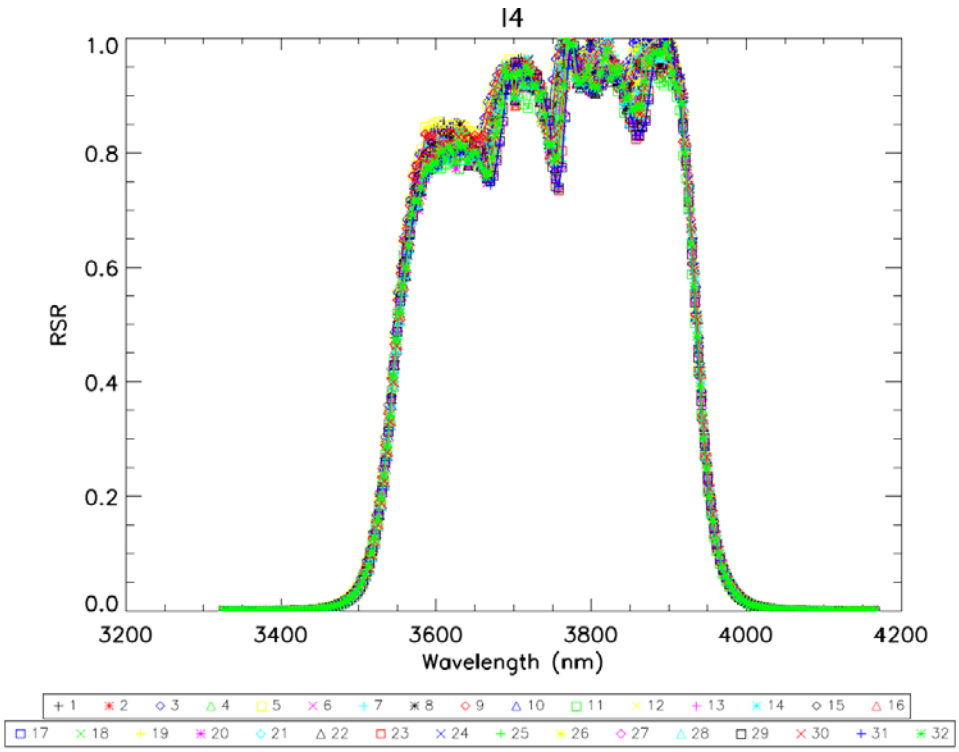

Figure 18: RSR for I4 SS1

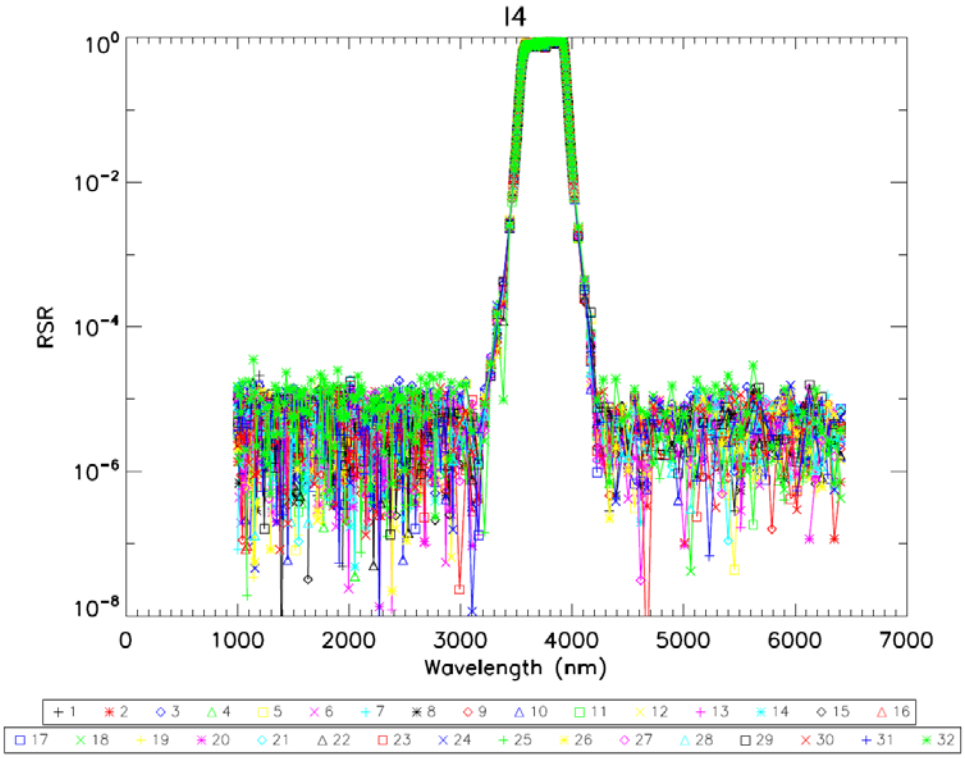

Figure 19: Deviation of center wavelength for average for all SMWIR

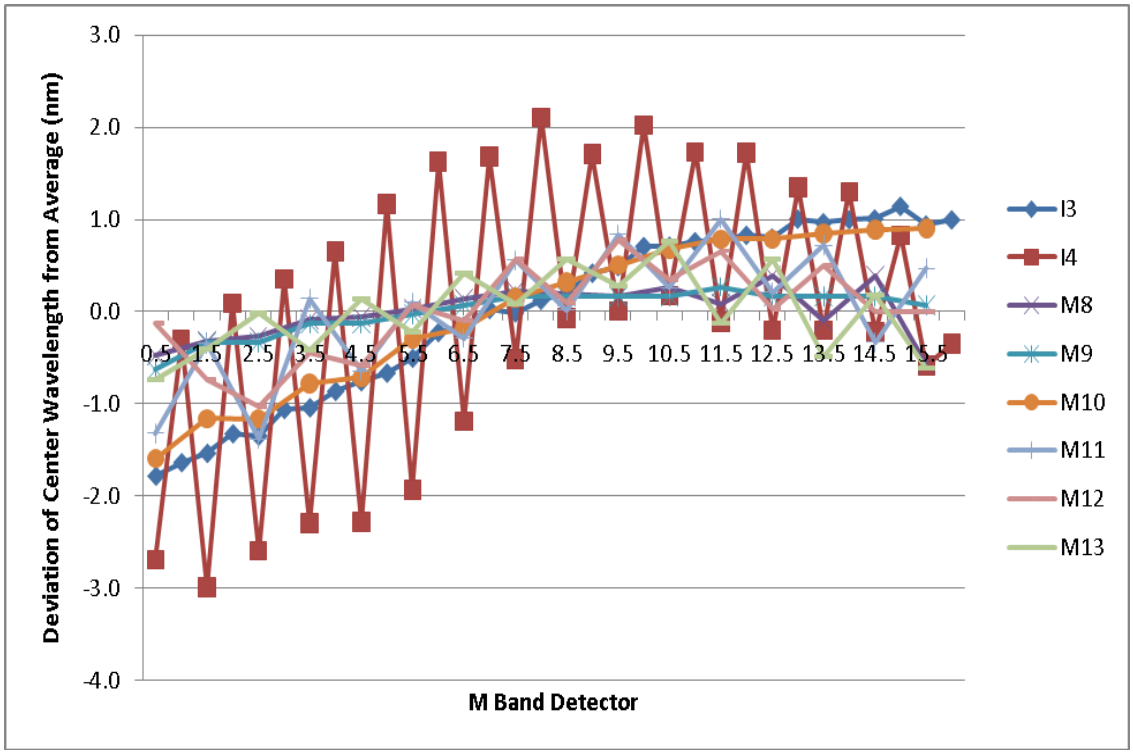

Figure 20: EDU M8 IB RSR for odd detectors (minus edge detectors)